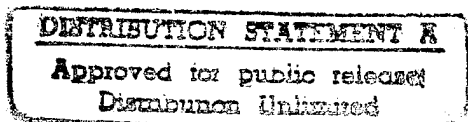


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NOTICE

The above identified patent application is available for licensing. Requests for information should be addressed to:

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DTIC QUALITY INSPECTED 1

1 Navy Case No. 76643

2
3 SEALING APPARATUS FOR EXCLUSION
4 OF WATER FROM UNDERWATER GUN BARRELS

5
6 STATEMENT OF GOVERNMENT INTEREST

7 The invention described herein may be manufactured and used
8 by or for the Government of the United States of America for
9 governmental purposes without payment of any royalties thereon or
10 therefor.

11
12 BACKGROUND OF THE INVENTION

13 (1) Field of the Invention

14 The present invention relates to a sealing apparatus for
15 keeping water out of an underwater gun barrel both before, during
16 and after the first shot and between shots in a series. More
17 particularly, the invention relates to a novel sealing means for
18 creating and maintaining a watertight seal on the muzzle of a gun
19 barrel.

20 (2) Description of the Prior Art

21 Little work has been done on apparatus for keeping water out
22 of a gun barrel because until recently it has not been practical
23 to shoot bullets underwater. Newly proven, supercavitation drag
24 reduction techniques now allow bullets to be fired underwater at
25 high enough speeds to cause damage. Accordingly, there is a need

1 for a simple and effective means for sealing underwater gun
2 barrels to preclude the entry of water.

3 Excluding water from a gun barrel is important to underwater
4 gun operation. If water is allowed to enter the gun barrel
5 before or after firing the gun, the gun will not operate
6 effectively.

7 The prior art includes various devices relating to
8 underwater guns such as disclosed in U.S. Patent No. 44,631;
9 367,153; 1,270,988; 3,300,888; 3,616,561; 3,323,457; 3,729,853;
10 and 4,821,441. For example, U.S. Patent No. 44,631 discloses a
11 submarine shot conductor having an India-rubber valve mounted on
12 the open end of the shot barrel. Similarly, U.S. Patent No.
13 1,270,988 discloses an underwater gun whereby the gun muzzle is
14 sealed by a pivotally mounted cap portion. U.S. Patent No.
15 367,153 discloses a submarine gun and port whereby the port which
16 receives the gun barrel is exposed by means of a sliding gate.
17 Multishot guns for underwater use are disclosed in U.S. Patent
18 Nos. 4,821,441; 3,729,853; and 3,616,561. These prior art
19 devices do not provide adequate sealing of the gun barrel to
20 preclude the entry of water and/or are overly complex and not
21 practical underwater guns.

22 Other devices are known in the art to render firearms
23 waterproof as disclosed in U.S. Patent Nos. 3,677,132; 4,742,775;
24 4,848,209; and 5,105,571. For example, U.S. Patent No. 3,677,132
25 illustrates a muzzle attachment for the barrel of a firearm. The

1 muzzle attachment includes a sealing device which prevents the
2 escape of expanding gases after a bullet has been fired.

3 Similarly, U.S. Patent No. 5,105,571 also relates to a
4 method and apparatus for preventing moisture from entering a
5 firearm. In this patent, lightweight plastic covers are
6 disclosed for sealing the openings in a firearm.

7 U.S. Patent 4,848,209 discloses a sealing apparatus for an
8 underwater device including a barrel holder, a barrel for guiding
9 a fastener intended to be driven by the gases of a propulsive
10 charge and a percussion system for setting of the charge. The
11 barrel of the device is closed by a closure device made by a
12 material which may be perforated by the projectile disposed
13 inside the tubular element or gun barrel.

14 U.S. Patent No. 4,742,775 illustrates still another approach
15 for sealing an end of an underwater device. In this patent, a
16 sealing compound is used to prevent water from penetrating the
17 casing.

18 Thus, the prior art does not disclose or suggest a device
19 which can be easily mounted onto a conventional multi or single
20 barreled gun which will render the gun barrel watertight and
21 permit the gun to be fired without damaging the watertight seal.

22 SUMMARY OF THE INVENTION

23 Accordingly, it is a primary object of the invention to
24 provide an effective sealing means to keep water out of an
25 underwater gun barrel.
26

1 It is a further primary object of the invention to provide
2 an effective sealing means to keep water out of an underwater gun
3 barrel so that a bullet or other projectile is enveloped in gas
4 until it leaves the gun barrel.

5 These objects are accomplished with the present invention by
6 providing a muzzle sealing means which engages the gun muzzle and
7 which frictionally engages a sealing plate means. The sealing
8 plate has one or more firing apertures through which a bullet or
9 other projectile can be fired when aligned with the gun muzzle.

10 The sealing plate keeps water from entering the gun barrel
11 except when the apertures are aligned with the gun barrel.
12 Discharge of the firing gun barrel is timed so that the bullet or
13 other projectile and combustion gases keep the water from
14 entering the firing aperture during the barrel-aperture alignment
15 period. This keeps water out of the gun barrel and thereby
16 reduces the amount of energy needed to eject a bullet or other
17 projectile, and increases the muzzle velocity of the bullet.

18 The novel sealing means of the invention is applicable to
19 single and multibarreled guns. The sealing means includes a
20 muzzle seal means which engages a gun muzzle of the gun barrel.
21 The muzzle seal means comprises tubular face seal means for
22 engaging the gun muzzle, a shaft seal means for sealing the face
23 seal and a spring means for providing down-load pressure. The
24 muzzle seal means frictionally engages a sealing plate means
25 attached to the gun. The sealing plate means includes one or
26 more firing apertures for alignment with the gun muzzle for

1 firing the gun barrel. The sealing plate or the gun muzzle
2 rotates to align the gun muzzle and firing aperture of the
3 sealing plate for firing the gun.

4
5 BRIEF DESCRIPTION OF THE DRAWING

6 A more complete understanding of the invention and many of
7 the attendant advantages thereto will be readily appreciated as
8 the same becomes better understood by reference to the following
9 detailed description when considered in conjunction with the
10 accompanying drawing wherein:

11 FIG. 1 is a side view of a Gatling gun using the sealing
12 means of the invention;

13 FIG. 2 is an enlarged and partial sectional view of the
14 muzzle seal means of FIG. 1 showing the details of the muzzle
15 seal on the gun muzzle;

16 FIG. 3 is a front view of FIG. 1 showing the firing aperture
17 of the sealing plate and the gun muzzles in non-firing position;

18 FIG. 4 is a front view of FIG. 1 showing the firing aperture
19 of the sealing plate and the gun muzzles in firing position;

20 FIG. 4A is an alternative embodiment of the firing aperture of
21 the sealing plate of FIG. 1;

22 FIG. 5 is a side view of a single barrel gun using the
23 sealing means of the invention;

24 FIG. 6 is an enlarged partial sectional view of FIG. 5
25 showing the muzzle seal, sealing plate and actuating means for
26 rotating the sealing plate;

1 FIG. 7 is a front view of FIG. 5 which shows the sealing
2 plate with multiple firing apertures and in firing position;

3 FIG. 8 is an enlarged plan side view of another single
4 barrel gun in which a sealing plate is slidably mounted with a
5 single firing aperture in relation to the gun muzzle;

6 FIG. 9 is an enlarged side view of the sealing means of FIG.
7 8; and

8 FIG. 10 is a front view of FIG. 8 in firing position.
9

10 DESCRIPTION OF THE PREFERRED EMBODIMENT

11 A first preferred embodiment of the sealing apparatus of the
12 invention is illustrated on a multi-barreled gun such as a four
13 barreled Gatling gun generally designated as 10 in FIG. 1.
14 Generally, Gatling gun 10 has multiple gun barrels 12. As shown
15 in FIG. 1, gun 10 has four barrels 12. Each barrel 12 has a gun
16 barrel muzzle 14 and muzzle seal 16. A sealing plate 18 is
17 connected to a gun housing 19 by bracket means 20 and supporting
18 rods 22. A support ring 24 is utilized for further support along
19 barrels 12.

20 As seen in FIG. 2, muzzle seal 16 fits over and engages the
21 gun barrel muzzle 14. Muzzle seal 16 comprises a tubular face
22 seal 26, a shaft seal 28, and a spring means 30. The face seal
23 16 is made of any seawater resistant material such as carbon,
24 ceramic or other like material. Besides being seawater
25 resistant, the material must resist the high temperature of the
26 combustion gases upon firing of the gun 10. Face seal 26 is

1 slidably mounted. Shaft seal 28 is fitted in a groove in the
2 interior of the face seal 16 and preferably includes an O-ring.
3 The shaft seal 28 provides a watertight seal between the face
4 seal 26 and the gun muzzle 14.

5 Spring means 30 engages a stop means 32 and provides
6 frictional down-load pressure on the face seal 26 against sealing
7 plate 18. This pressure ensures a watertight seal between muzzle
8 seal 16 and sealing plate 18.

9 Sealing plate 18, as best shown in FIGS. 3 and 4, includes a
10 firing aperture 34. The sealing plate is attached to the gun 10
11 by means of threaded support rods 22 which are held in place by
12 nut means 36 or any other suitable fastening means.

13 FIG. 3 illustrates the sealing plate 18 in non-firing
14 position with the gun muzzles 14 with face seals 26 (shown in
15 phantom lines). None of the gun muzzles 14 are in alignment with
16 firing aperture 34.

17 FIG. 4 illustrates the sealing plate 18 in firing position
18 wherein a gun muzzle 14 is in alignment with firing aperture 34.
19 As apparent, the face seal 26 of muzzle seal 16 has a larger
20 diameter than the firing aperture 34.

21 In operation, one muzzle seal 16 is mounted on each gun
22 muzzle 14 and frictionally engages sealing plate 18. The gun
23 barrels 12 rotate half a position and firing begins. The gun
24 barrels 12 rotate one full position between shots. When firing
25 is completed, the gun barrels 12 rotate a half of position to
26 seal the face seal 26 of muzzle seal 16 against the sealing plate

1 18. The discharge of each gun barrel 12 is timed so that the
2 projectile and combustion gases keep the water from entering
3 firing aperture 34. As seen in FIG. 4A, firing aperture 34 can
4 be oblate to allow combustion gases to escape after the barrel 12
5 has begun moving the next firing position.

6 FIGS. 5 through 7 illustrate a single barrel gun 40 having a
7 gun barrel 42, a muzzle 44, a muzzle seal 46, a sealing plate 48
8 and a waterproof actuating means 50 which rotates sealing plate
9 48. The sealing plate 48 is fastened to actuating means 50 by a
10 shaft and fastener assembly 51 and 53. Actuating means 50 can be
11 joined to gun barrel 42.

12 FIG. 6 illustrates in greater detail the sealing apparatus
13 of the invention on the gun muzzle 44. The muzzle seal 46 is
14 constructed and arranged as described above for the Gatling gun.
15 Muzzle seal 46 includes a tubular face seal 52, a shaft seal 54,
16 and a spring means 56. Spring means 56 engages stop means 58 and
17 provides for frictional engagement of face seal 52 with sealing
18 plate 48. Sealing plate 48 can be provided with a groove 49 to
19 accommodate face seal 52 thereby enhancing sealing. As shown, a
20 support arm 64 is provided with a support wheel 66 to maintain
21 sealing plate 48 against face seal 52.

22 As seen in FIG. 7, sealing plate 48 includes multiple firing
23 apertures 60. Sealing plate 48 is rotated by actuating means 50.
24 Actuating means 50 can be any shaft 51 rotating means. It is
25 envisioned that actuating means be driven by the same mechanism
26 used to feed the bullets. As an alternative, actuating means 50

1 can be a stepper motor capable of accurately aligning aperture 60
2 with muzzle 44. As shown in FIG. 7, the sealing plate 48 is
3 rotated to align the firing apertures 60 with the gun muzzle 44.
4 Firing of the single barrel gun 40 is similar to that described
5 for the Gatling gun of FIG. 1 except that sealing plate 48 is
6 rotated by the actuating means 50.

7 As seen above for the Gatling gun, the face seal 52 is of a
8 larger diameter than the firing aperture 60 to provide for an
9 effective watertight seal.

10 FIGS. 8 through 10 disclose another embodiment of the
11 invention on a single barrel gun. The single barrel gun includes
12 a gun barrel 70 with a gun muzzle 72. A muzzle seal 74, a
13 sealing plate 76 and an actuating means 78 are provided in the
14 embodiment of the invention. The muzzle seal 74 is the same as
15 described above for the previous embodiments and includes a face
16 seal 80, a shaft seal means (not shown) and a spring means 82.
17 Face seal 80 is slidably disposed on muzzle 72. Spring means 82
18 engages stop means 84 and provides for frictional engagement of
19 face seal 80 with sealing plate 76. Sealing plate 76 is attached
20 to gun barrel 70 by a corrosion resistant bracket 88. In
21 operation, actuating means 78 causes sealing plate 76 to slide to
22 align a firing aperture 86 with gun muzzle 72. Actuating means
23 78 can be a solenoid or hydraulic actuator having the ability to
24 precisely align aperture 86 with muzzle 72.

As seen for the above-description, the sealing apparatus of this invention provides a novel and simple means for providing a watertight seal for an underwater gun.

In light of the above, it is therefore understood that the invention may be practiced otherwise than as specifically described.

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2
3 SEALING APPARATUS FOR EXCLUSION
4 OF WATER FROM UNDERWATER GUN BARRELS
5

6 ABSTRACT OF THE DISCLOSURE

7 A sealing apparatus which may be mounted on multi or single
8 barreled guns is disclosed to provide a watertight seal on an
9 underwater gun. The sealing apparatus comprises a sealing plate
10 connected to a gun barrel and a muzzle seal which fit on the
11 muzzle of the gun barrel and frictionally engages the sealing
12 plate. The sealing plate includes a firing aperture which aligns
13 with the gun barrel when the gun is fired.

